AD NUMBER
AD015014
CLASSIFICATION CHANGES
TO: **unclassified**
FROM: **confidential**
LIMITATION CHANGES
TO: **Approved for public release; distribution is unlimited.**
FROM: **Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; SEP 1952. Other requests shall be referred to Naval Proving Ground, Dahlgren, VA.**
AUTHORITY
30 Sep 1964, DoDD 5200.10; USNSWD ltr, 18 Nov 1975

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO 1037

COMBAT AIR OPERATIONS GUIDED MISSILE FUZES;
RESEARCH, DEVELOPMENT, TESTS AND REPORTS OF

7th Partial Report

- -

FUZING SYSTEM FOR XSAM-N-4.
GUIDED MISSILE DOVE; TESTING OF

3rd Partial Report

Task Assignment NPG-Re2b-34-1-52

Copy No. 9

Classification CONFIDENTIAL SECURITY INFORMATION

Fuzing System for XSAM-N-4, Guided Missile Dove; Testing of

PART A

SYNOPSIS

1. This is a summation report on all aircraft drop tests and related reports on the Dove fuzing system done to date at the Naval Proving Ground. Current field tests have been suspended. However, it is anticipated that the program will be reinstated as soon as design difficulties are alleviated.

2. The object of the aircraft drop tests as herein reported was to determine the following:

a. Arming time of the fuzing system at ambient temperature.

b. Fuze XB-44A safety on accidental release.

c. Fuze XB-44A reliability on water impact.

3. It is concluded that:

a. The arming time of the fuzing system is too short.

b. The Fuze, XB-44A, will not function when released safe from an altitude of 100 feet onto concrete.

c. The Fuze, XB-44A, will function satisfactorily when dropped from 8,000 feet into water at ambient temperature.

4. It is recommended that the arming system be redesigned to increase the arming time to a minimum of 6 seconds, preferably 7 or 8 seconds.

TABLE OF CONTENTS

Fuzing System for XSAM-N-4, Guided Missile Dove; Testing of

PART B

INTRODUCTION

1. AUTHORITY:

Reference (a) authorized the Naval Proving Ground to perform such tests on the fuzing system for the XSAM-N-4, Guided Missile Dove, as might be requested by the Naval Ordnance Laboratory. This test was requested by reference (b) which outlined the test requirements. Work was initiated under Task Assignment No. NPG-04-Re2b-33 as authorized by reference (c) and completed under Task Assignment No. NPG-4-Re2b-34-1-52 as authorized by reference (d). The transfer of funds was authorized by reference (e). Current field tests have been suspended by authority of reference (f).

2. REFERENCES:

a. BUORD ltr NP9 Re2b-286-2 FLY:ss of April 1949
b. NOL conf ltr NP51/S71-8(3-615) Ser 01641 of 19 Dec 1950
c. BUORD conf ltr NP30(Re2b) JWG:ss of 25 May 1950
d. BUORD conf ltr NP9-Re2b-DB LaP:bjn Ser 23946 of 4 Aug 1951
e. BUORD conf ltr NP9-Rexb-JBC:pcb Ser 29835 of 29 Nov 1951
f. NOL conf ltr NP/NOL/X11(649) Ser 0751 of 31 March 1952
g. NPG Report No. 441 of 13 Dec 1949
(First Partial, T.A. No. NPG-25-Re2b-286-3)
h. NPG Report No. 477 of 24 Jan 1950
(Second Partial, T.A. No. NPG-25-Re2b-286-3)
i. NPG Report No. 529 of 27 March 1950
(Third Partial, T.A. No. NPG-04-Re2b-309)
j. NPG Report No. 825 of 4 Aug 1951
(Fourth Partial, T.A. No. NPG-04-Re2b-33)
k. NPG Report No. 933 of 20 March 1952
(Fifth Partial, T.A. No. NPG-Re2b-34-1-52)
l. NPG Report No. 844 of 11 Aug 1951
(First Partial, T.A. Nos. NPG-Re3d-414-1-51 and NPG-Re3d-439-2-51)

3. BACKGROUND:

a. The Bureau of Ordnance requested the Naval Ordnance Laboratory to assume technical direction of the development and testing of a tail fuzing system for the XSAM-N-4, Guided Missile Dove. The Naval Proving Ground was requested to perform such tests on the project as might be directly requested by the Naval Ordnance Laboratory.

b. The XSAM-N-4, Guided Missile Dove consists of an AN-M65 1000 lb. G.P. bomb body fitted with special nose and tail sections. Figure 1 shows the nose section which contains the homing and guidance control mechanisms. The homing mechanism is of the infrared, i.e., heat sensitive type. This mechanism controls guidance by means of four spoiler scoops which project through slots in the nose section. In order to allow the infrared mechanism to operate the proper spoiler to change range or deflection, the missile is roll-stabilized. This is accomplished by means of gyro controlled ailerons on the tail fins. Figure 2 shows the tail section which contains the roll-stabilization system and the missile power supply. The windmill on the after part of the tail section drives a generator which supplies all the power used by the missile. The fuzing system consists of an arming motor which is driven by the generator, the Fuze, XB-44A, and the associated wires and safety switches.

c. Reference (g) is the first partial report on the test of the preliminary design of the Fuze XB-44A. This test ascertained that the sensitivity of the subject fuze when set for instantaneous firing upon water impact was sufficient to obtain the desired action.

d. Reference (h) is the second partial report on the test of the preliminary design of the Fuze, XB-44A. The fuzes were assembled in 1000 lb. and 500 lb. inert loaded bombs, armed and fired against 1 1/2" STS plate. All of the fuzes except one appeared externally to withstand plate impact. The one fuze was broken. All of the fuzes were returned to the Naval Ordnance Laboratory for internal examination.

e. Reference (i) is the third partial report on the test of the preliminary design of the Fuze, XB-44A. The fuzes were assembled in 500 lb. inert loaded bombs, armed and fired against 1 1/2" STS plate at 30 degrees obliquity. The results indicated that the fuzes would not function at an impact velocity of 900 feet per second under these conditions.

f. Reference (j) is the fourth partial report on the testing of the Fuze, XB-44A, and the first partial report on the field evaluation program as outlined by reference (b). The fuze was assembled in 1000 lb. inert loaded bombs and catapulted with a force of 9.0 g's to ascertain that the fuze would not arm when set on safe, or fire when armed. The results were satisfactory.

g. Reference (k) is the fifth partial report on the testing of the Fuze, XB-44A, and the second partial report on the field evaluation program. This test was conducted to devise a satisfactory method of conducting plate impact tests. It was determined that satisfactory impact conditions could be obtained by assembling the fuze in a 250 lb. inert loaded bomb and propelling the assembly with rocket motors from the Naval Proving Ground's 500 foot launcher Fuze tests have been conducted using this method and are to be the subject of a separate report.

h. Reference (l) is a report on the Ballistic Calibration of the Roll-Stabilized Non-Homing Dove. During a portion of the tests reported therein, fuze arming tests were conducted simultaneously. The results of the arming tests are discussed in this report.

i. This report is the sixth partial report on the testing of the Fuze, XB-44A, and the third partial report on the field evaluation program. The results of the tests herein reported show that the arming time of the Fuze, XB-44A, occurs in less than the required minimum time, necessitating alterations of the arming system. Therefore, reference (f) suspended current field tests and further advised that design changes were being made to make the fuzes suitable for mass production. In view of this, all unreported aircraft drop tests at the Naval Proving Ground are being included in this report.

4. OBJECT OF TEST:

The object of the tests reported herein was to determine the following:

a. Arming time of the fuzing system at ambient temperature.

b. Fuze, XB-44A, safety upon accidental release.

c. Fuze, XB-44A, reliability on water impact.

5. PERIOD OF TEST:

a.	Date Project Letter	19 December 1950
b.	Date Necessary Material Received	15 January 1951
c.	Date Commenced Tests	24 February 1951
d.	Date Tests Suspended	31 March 1952

6. REPRESENTATIVES PRESENT:

L. D. Moore	Naval Ordnance Laboratory
R. H. Moore	Naval Ordnance Laboratory
R. J. Happick	Naval Ordnance Laboratory
C. L. Gransee	Naval Ordnance Laboratory
A. Bodicky	Naval Ordnance Laboratory
H. Arron	Naval Ordnance Laboratory

PART C

DETAILS OF TEST

7. DESCRIPTION OF ITEM UNDER TEST:

The Fuze, XB-44A, is a tail fuze of the mechanical type. Figure 3 is a view of the fuze partially disassembled. Figure 4 is a sectionalized drawing of the fuze. When installed in the Dove missile, the fuze is armed by means of a motor which turns the arming shaft. This motor is driven by the same generator that supplies the power to the homing system. As the arming shaft rotates, it is withdrawn from the rotor by means of screw threads. After twelve turns it is withdrawn enough to permit the rotor to turn 90 degrees and align the two detonators. At the same time the detents which lock the inertia strikers are released, allowing the strikers to actuate the two primers on impact.

8. DESCRIPTION OF TEST EQUIPMENT:

a. For measuring the arming time of the fuzing system at ambient temperature, modified Fuzes, XB-44A, were assembled in XSAM-N-4 Guided Missiles Dove. To indicate arming, the Fuzes, XB-44A, were modified to incorporate an electric switch which would close on arming, allowing a current to flow to an externally mounted smoke signal. No explosive components were present in the fuzes. Inasmuch as the fuze arming motor and the homing mechanism of the Dove are driven by the same generator, arming times were measured with and without a simulated homing load. Thus the effect of the homing load on arming time could be determined. This simulated load drew power from the generator in the same amounts and times as the homing mechanism and thus saved the cost of expending a homing mechanism. Figure 5 shows the simulated load with the nose cover removed.

b. For determining fuze safety on accidental release, Fuzes, XB-44A, with loaded primers and detonators, and inert boosters were installed in 1000 lb. inert loaded bombs. A concrete target was used.

c. To ascertain the reliability on water impact Fuzes, XB-44A, were installed in 500 lb. live loaded bombs. Arming was accomplished by modifying the arming stem and vanes from an M162 Fuze. The stem was modified to fit the Fuze, XB-44A, and the vanes were modified to give a more satisfactory arming time. Figure 6 shows the fuze and modified arming stem and vanes assembled. Two Mitchell cameras with 6 and 17 inch lenses were used to photograph impacts.

9. PROCEDURE:

a. For measuring arming time of the fuzing system at ambient temperatures, Fuzes, XB-44A, modified as described in paragraph 8.a., were assembled in the XSAM-N-4 Guided Missile Dove. Arming times and applied voltages were checked on the ground. This was done by mounting the missile on a motor stand and turning the generator 7500 r.p.m. In the missiles with the simulated load, the load was applied 4 seconds after the arming wire had been pulled. This was done by a load timing mechanism which simulated the actual loads of the homing device. Applied fuze voltages before and after load application were measured and recorded. Immediately prior to dropping, a ready test was made on the generator by checking its output voltage at 7500 r.p.m. Thirteen missiles were dropped, of which seven contained the simulated load. These drops were made primarily to obtain ballistic data; however, arming data was obtained simultaneously. These drops were made from an AD-2 aircraft at altitudes of 19,708 to 30,137 feet and true airspeeds of 192 to 247 knots. All drops were made over water.

b. To determine fuze safety upon accidental release, the fuzes with inert boosters assembled in inert bombs were dropped on a concrete target. The dropping aircraft was a TBM-3E type flying at an altitude of 100 feet and at an indicated airspeed of 100 knots. The fuzes were pre-armed from 2 3/4 to 3 1/4 turns, thus placing the fuze in the calculated arming condition had it been assembled and dropped in a Dove missile under these conditions. As previously stated, twelve turns fully arms the fuze.

c. To measure fuze reliability on water impact, the fuzes, modified as described in paragraph 8.c., had approximately a 250 millisecond delay built in. To save the cost of a Dove missile, a 500 lb. live loaded bomb was used. Since the bomb was live loaded a suitable method had to be found to insure that the bomb would not arm until it was beyond the minimum safety area of the aircraft. This is a distance of 650 feet for a 500 lb. G.P. bomb and requires an arming delay of 6.4 seconds. To obtain this delay with the modified arming stem and vanes from an M162 Fuze, the vanes were bent 60 degrees. This method of obtaining correct arming time was arrived at empirically through an investigation using inert fuzes with a switching system similar to those in arming tests. The dropping aircraft was a TBM-3E type flying at an altitude of 8,000 feet and at an indicated airspeed of 150 knots. All drops were made into water. From the film taken by two Mitchell cameras, the time intervals between impact and detonation were measured.

10. RESULTS AND DISCUSSION:

a. The arming times of the fuzing system as installed in the Dove missile were from 4.1 to 4.9 seconds. The absolute minimum release altitude for a 1,000 lb. G.P. live loaded bomb as established by the Naval Proving Ground is 750 feet. The normal minimum is 2500 feet. In 4.3 seconds an AN-M65A1 1,000 lb. bomb will fall 300 feet. It requires 6.8 seconds for the bomb to fall 750 feet. During this investigation it was ascertained that the simulated load made no appreciable change in the arming time. The results of the tests conducted to determine the foregoing are tabulated in Table I.

b. Fuze safety upon accidental release was satisfactory. None of the fuzes dropped incurred any internal damage due to the initial impact. Drop No. five bounced after striking the concrete target and hit on the tail, smashing the fuze. The explosive train was in a safe condition when recovered. Figure 7 shows the fuzes after recovery. Table II contains detailed dropping data and results.

c. The data obtained from the water impact drops showed that the fuze had an impact delay of 290 to 350 milliseconds. Since the design delay was 250 milliseconds, this shows that the fuze mechanism withstood water impact sufficiently to operate satisfactorily. Detailed results are contained in Table III. The results of the M162 Fuze vane angle investigation are contained in Table IV.

PART D

CONCLUSIONS

11. It is concluded that:

a. The arming time of the fuzing system is too short.

b. The Fuze, XB-44A, will not function when released safe from an altitude of 100 feet onto concrete.

c. The Fuze, XB-44A, will function satisfactorily when dropped from 8,000 feet into water at ambient temperature.

PART E

RECOMMENDATIONS

12. It is recommended that the arming system be redesigned to increase the arming time to a minimum of 6 seconds, preferably 7 to 8 seconds.

PART F

DISPOSITION OF MATERIAL

13. The only items recovered were the five fuzes that were dropped to check safety upon accidental release. These were returned to the Naval Ordnance Laboratory for internal examination and retention.

Fuzing System for XSAM-N-4, Guided Missile Dove: Testing of

The tests upon which this report is based were conducted by:
J. B. KING, Aircraft Ordnance Stores Division
Aviation Ordnance Department
J. R. PETTERS, Bomb Fuze Section Engineer
Aircraft Ordnance Stores Division
Aviation Ordnance Department

This report was prepared by:
J. R. PETTERS, Bomb Fuze Section Engineer
Aircraft Ordnance Stores Division
Aviation Ordnance Department

This report was reviewed by:
J. B. KING, Head Engineer
Aircraft Ordnance Stores Division
Aviation Ordnance Department
R. T. LYNN, Lieutenant Commander, USN
Aircraft Ordnance Stores Officer
Aviation Ordnance Department
W. F. MILLER, Director of Research
Aviation Ordnance Department
R. S. CHANDLER, Commander, USN
Aviation Ordnance Officer
Aviation Ordnance Department
C. C. BRAMBLE, Director of Research
Ordnance Group

APPROVED: J. F. BYRNE
Captain, USN
Commander, Naval Proving Ground

E. A. RUCKNER
Captain, USN
Ordnance Officer
By direction

CONFIDENTIAL

NPG REPORT NO. 1037

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Seventh Partial Report

on

Combat Air Operations Guided Missile Fuzes;

Research, Development, Tests and Reports of

- -

Third Partial Report

on

Fuzing System for XSAM-N-4,

Guided Missile Dove; Testing of

Project No.: NPG-Re2b-34-1-52
Copy No.: 9
No. of Pages: 10

Date:
SEP 24 1952

CONFIDENTIAL
SECURITY INFORMATION

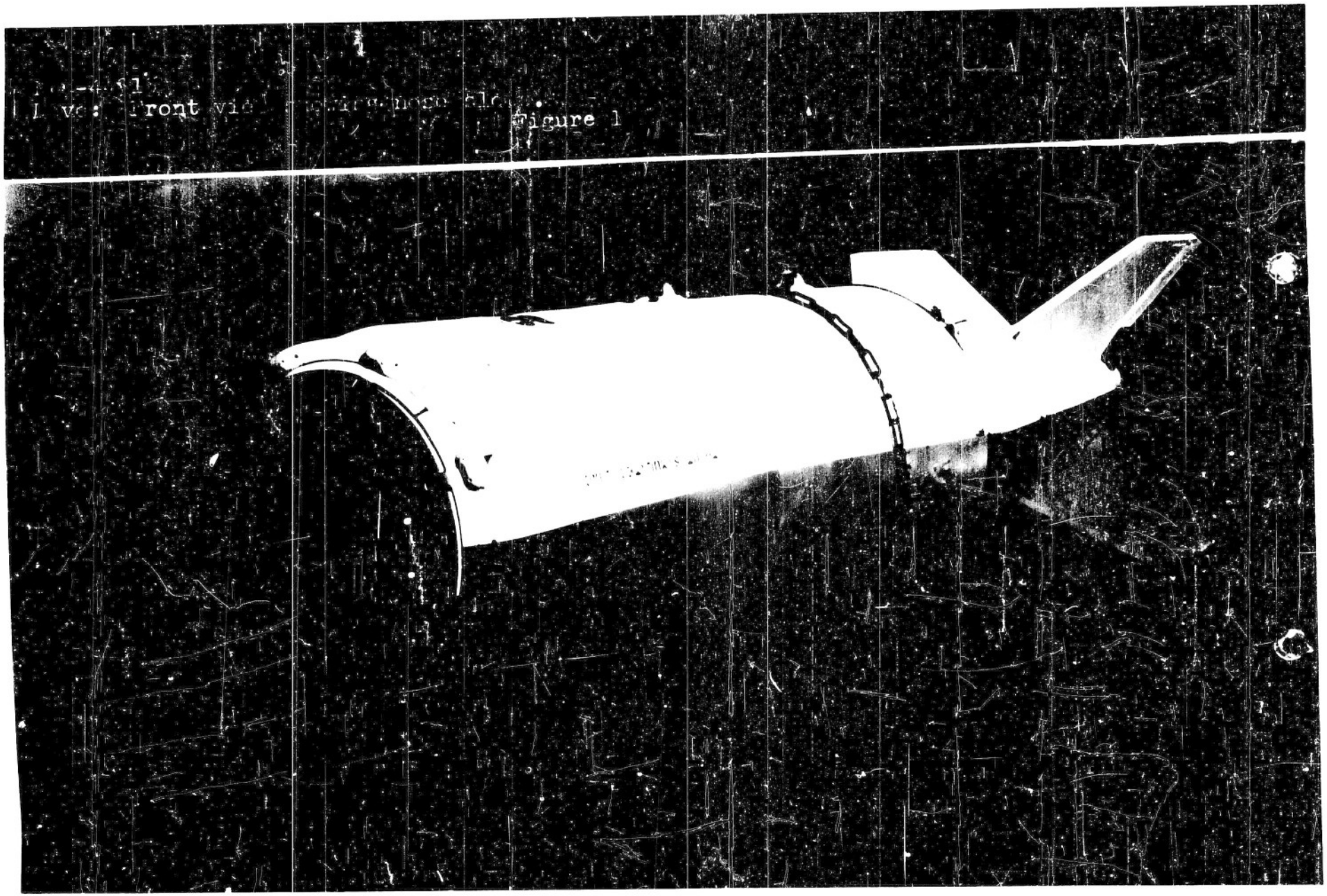
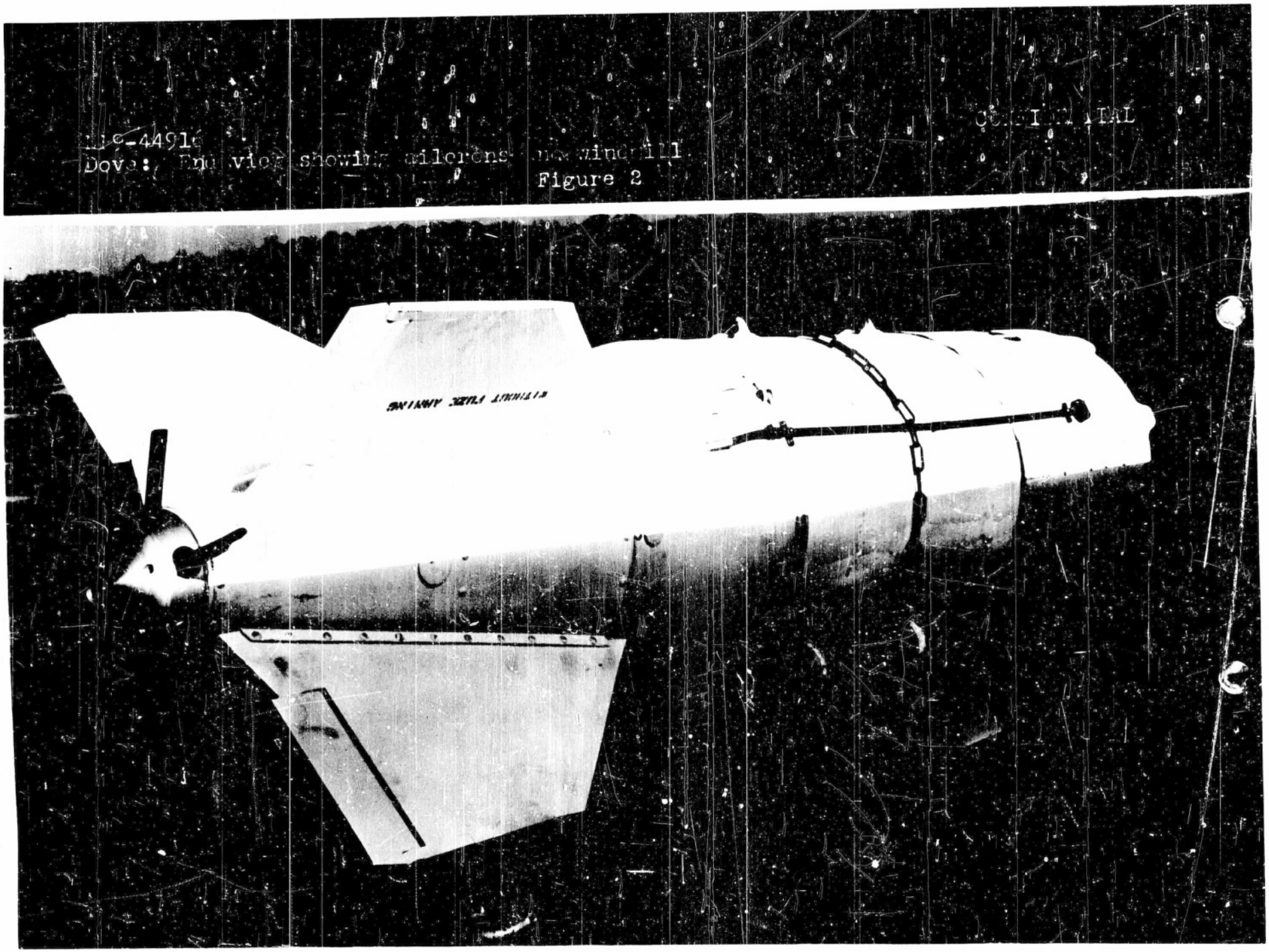


Figure 1

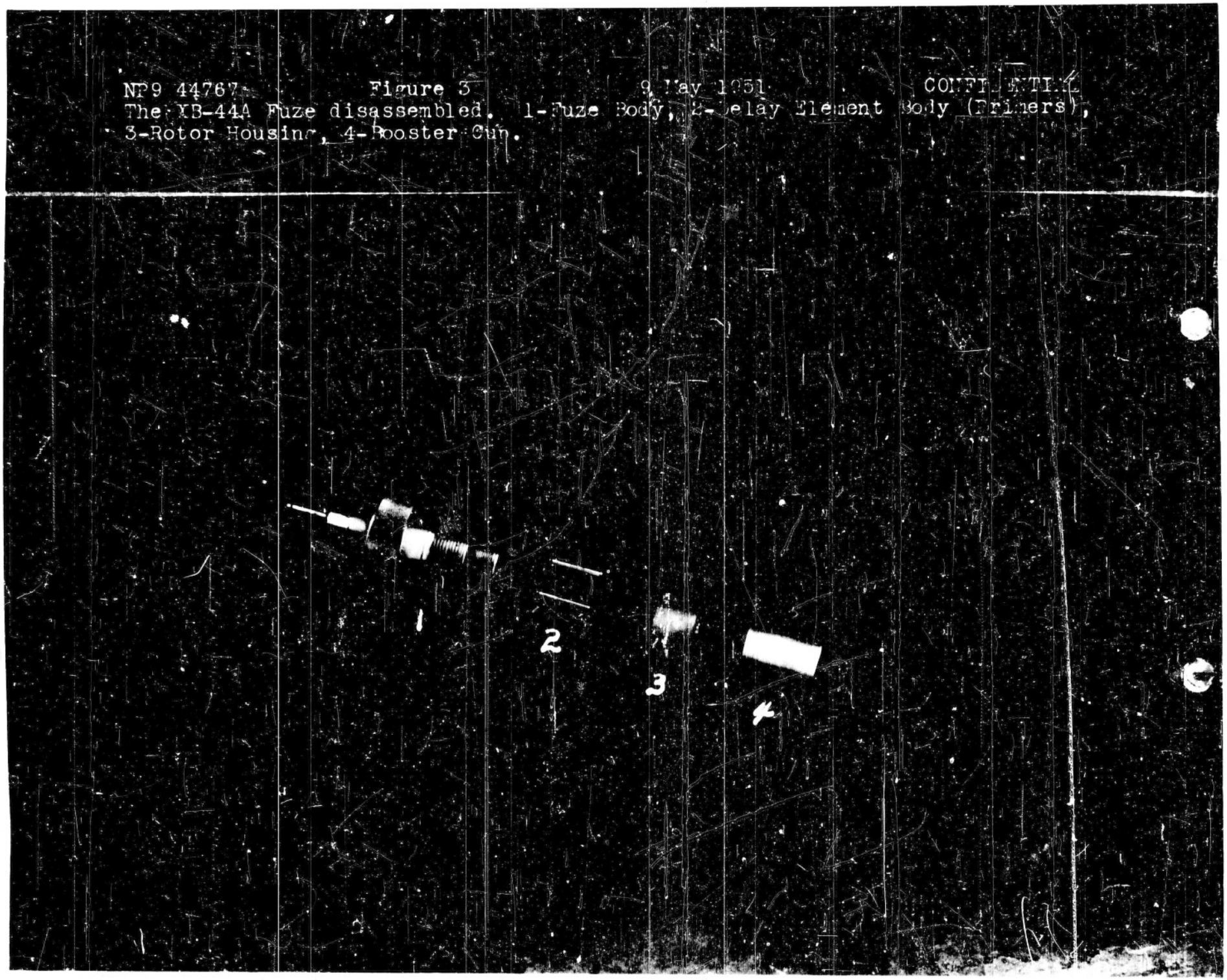
L-4491
Dove: End view showing ailerons and windmill

Figure 2



NP9 44767 Figure 3 9 May 1951 CONFIDENTIAL

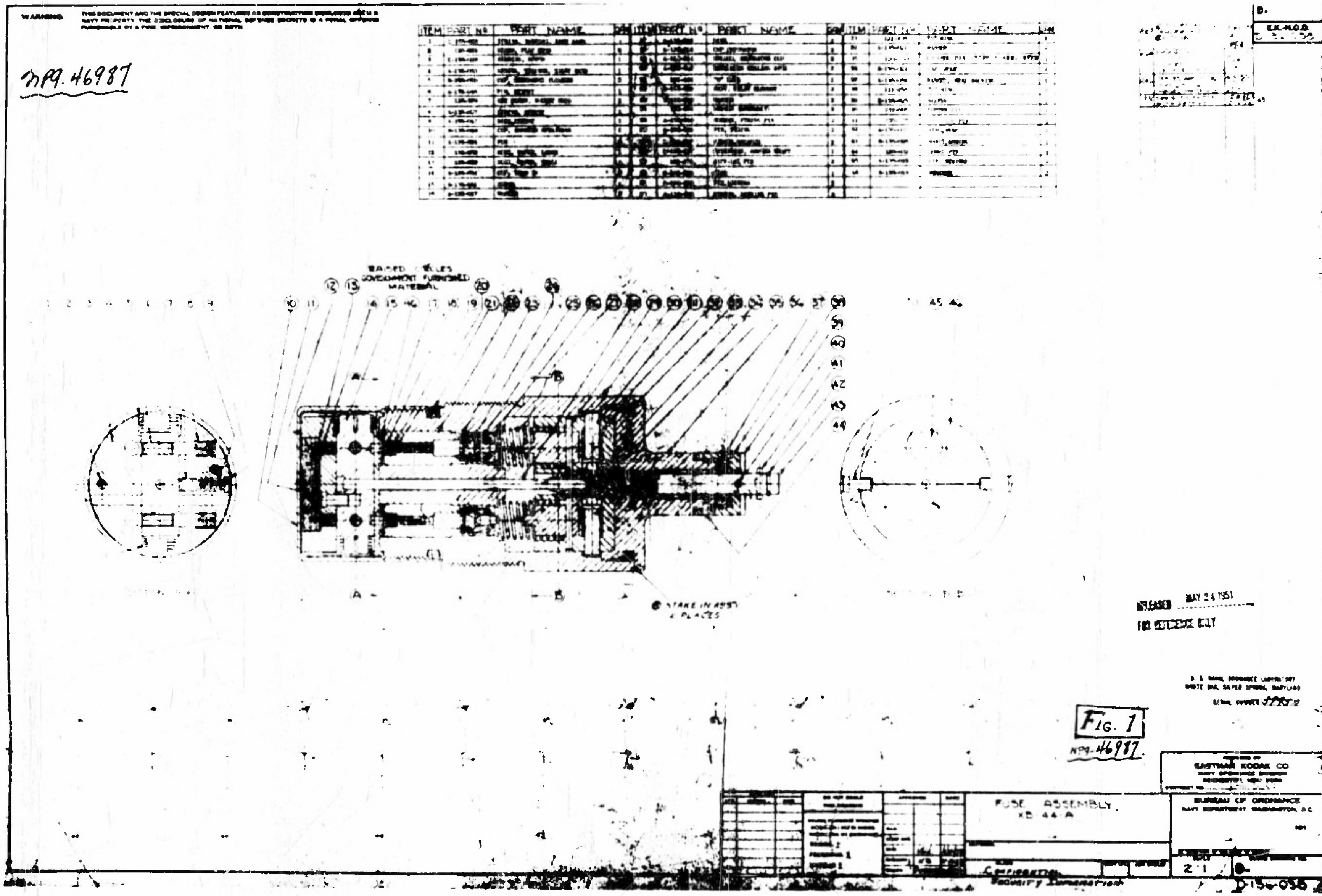
The XB-44A Fuze disassembled. 1-Fuze Body, 2-Delay Element Body (Primers), 3-Rotor Housing, 4-Booster Cup.



NP9-46987

Drawing of XB-44A Fuze Assembly.

CONFIDENTIAL
SECURITY INFORMATION

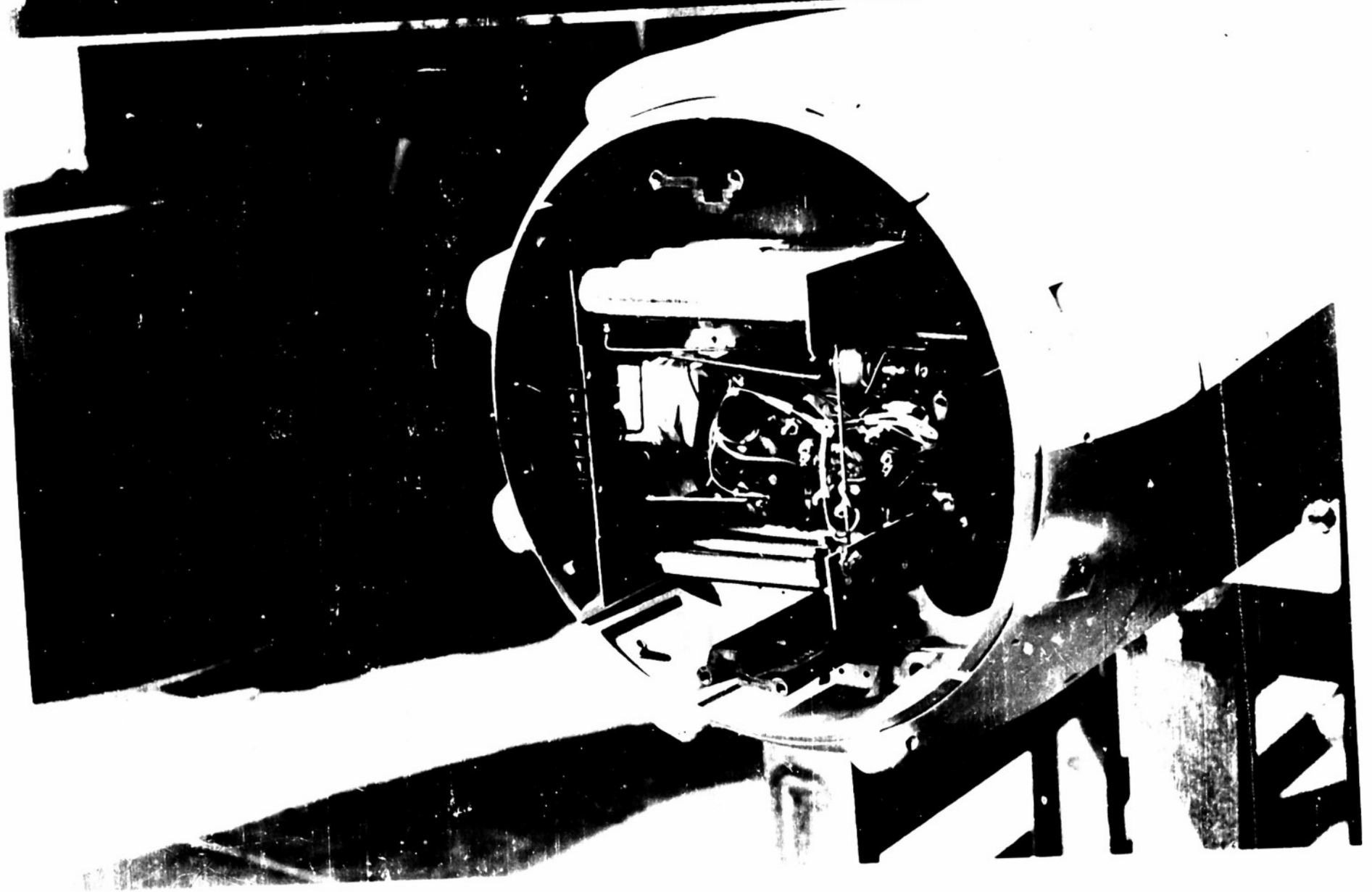


CONFIDENTIAL
SECURITY INFORMATION

8 May 1952

NP9-48986
XSAM-N-4 Guided Missile Dove with simulated homing load installed in nose section.
Nose cover has been removed.

Figure 5



CONFIDENTIAL
SECURITY INFORMATION

MP9-48987
XB-44A Fuze, assembled with modified extender and vane from M162 Fuze.
Figure 6

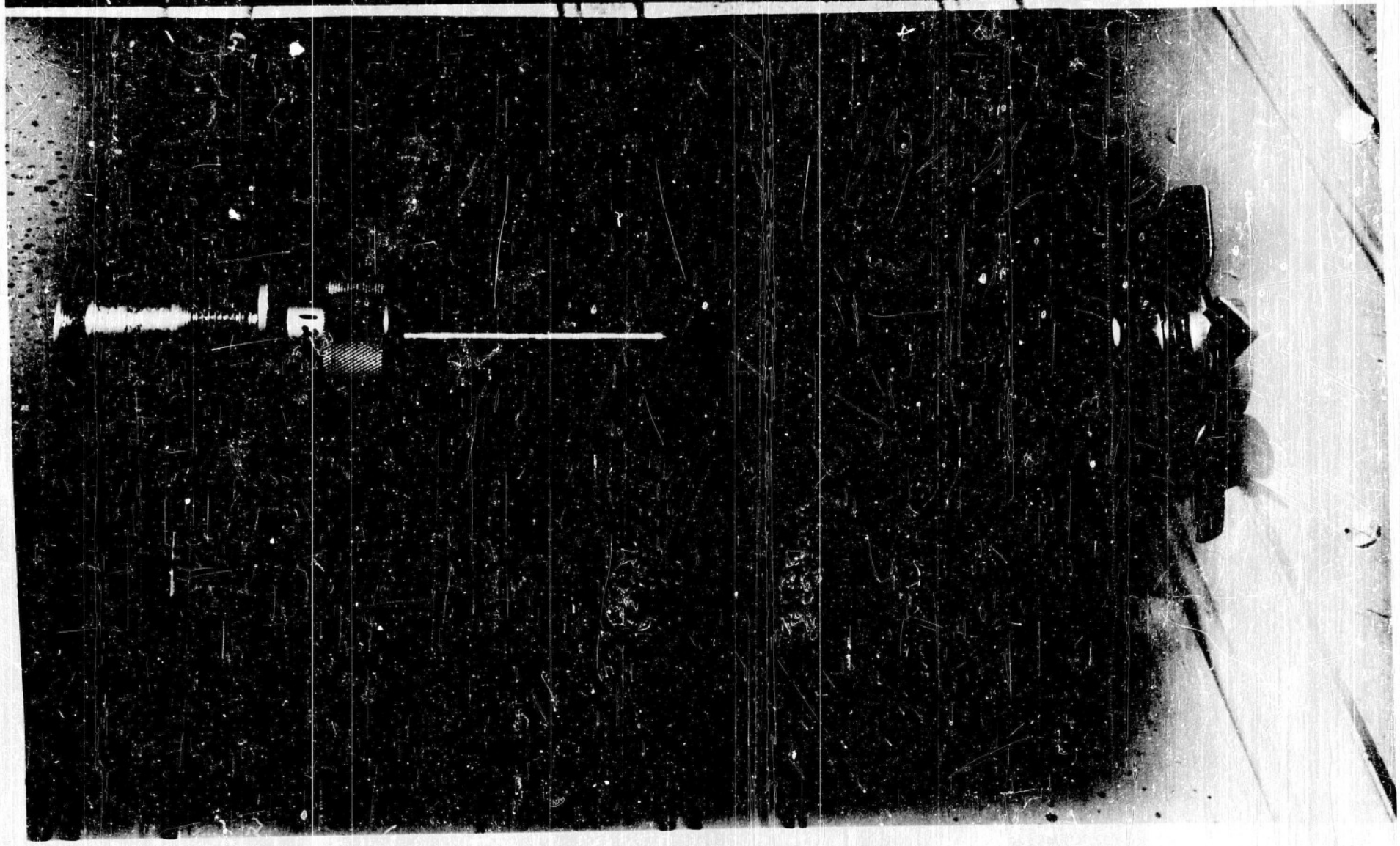


Figure 7

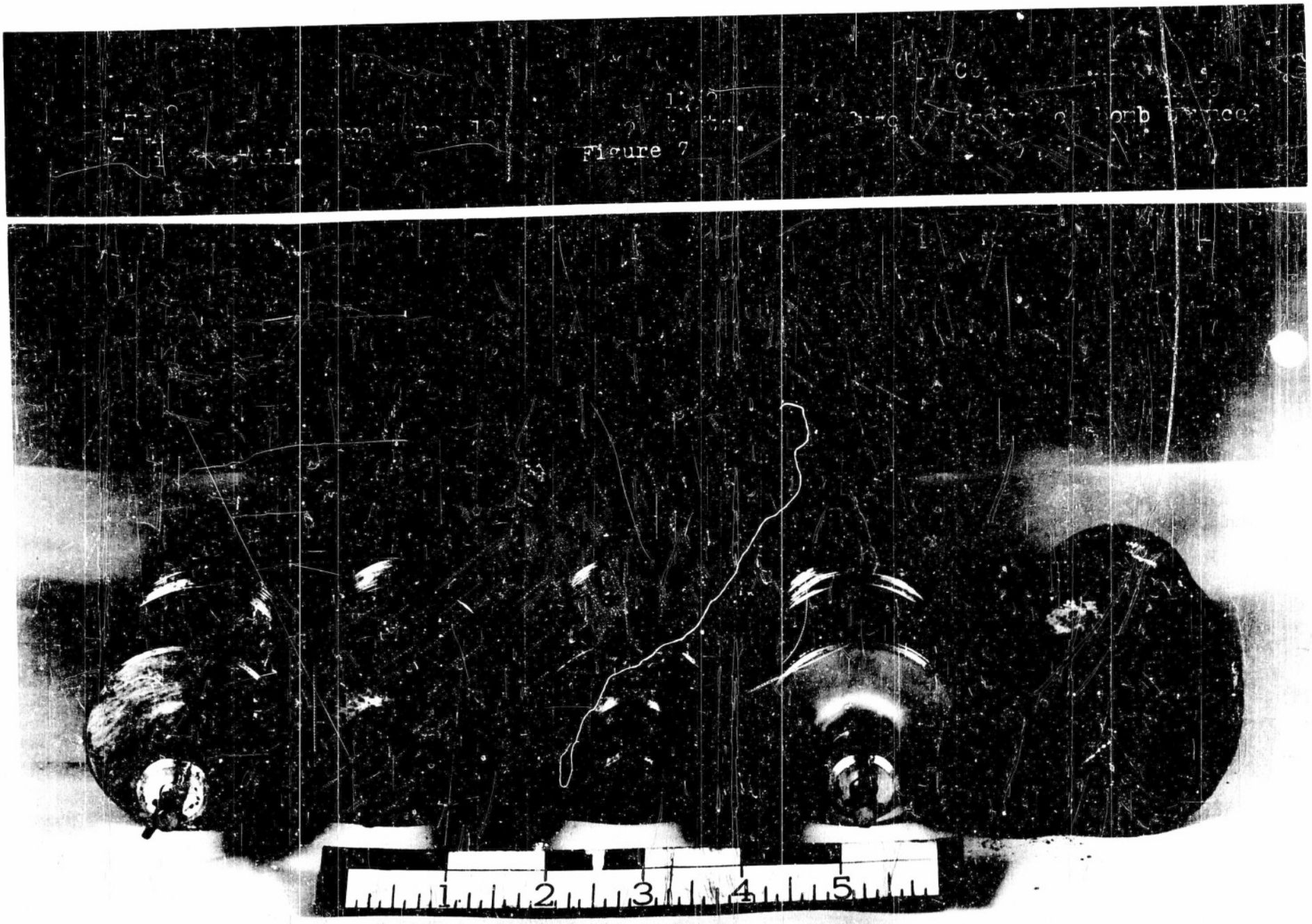


TABLE I

TEST DATA

on

FUZING SYSTEM ARMING

Drop No.	Date	Missile No.	Release Altitude (feet)	True Airspeed (mph)	Simulated Homing Load No.	Fuze No.	Ground Arming Check				Air Arming Time (sec)
							Date	Time (sec)	Initial Voltage	Voltage with Load	
1	3/2/51	211	20,467	246	2	240	2/26/51	4.5	30.5	23.5	4.1
2	3/2/51	213	20,400	240	5	207	2/28/51	4.7	30.0	21.5	4.1
3	3/2/51	214	20,493	238	None	145	3/2/51	5.0	30.0	None	4.6
4	3/9/51	207	19,684	235	1	166	3/6/51	4.6	30.0	21.0	No Data
5	3/9/51	209	19,708	221	6	159	3/6/51	4.8	30.0	19.0	4.9
6	3/9/51	217	19,785	233	7	191	3/2/51	4.7	30.0	18.0	4.6
7	3/10/51	215	19,573	243	4	187	3/7/51	5.2	30.5	20.0	4.9
8	3/10/51	219	19,595	230	9	175	3/8/51	4.7	30.5	20.0	4.6
9	3/10/51	218	24,530	260	None	164	1/22/51	5.2	28.0	None	4.6
10	3/17/51	208	29,818	246	None	205	2/12/51	4.5	28.3	None	4.1
11	3/17/51	210	30,124	284	None	153	2/26/51	4.6	30.0	None	4.5
12	3/17/51	212	29,972	276	None	162	2/26/51	4.7	28.0	None	4.5
13	3/17/51	216	30,137	279	None	225	2/26/51	4.7	30.0	None	4.4

Fuzing System for XSAM-N-4, Guided Missile Dove; Testing of

TABLE II

TEST DATA

on

FUZE ACCIDENTAL RELEASE

Item Under Test: Fuze XB-44A
Test Vehicle: AN-M65A1, 1000 lb. Inert Loaded Bomb with AN-113A1 Fin Assembly
Dropping Aircraft: TBM-3E type
Date Test Performed: 22 August 1951

Drop No.	Fuze No.	Release Altitude (feet)	I.A.S. (knots)	Pre-armed (No. turns)	Target	Results
1	92	100	100	2 3/4	Concrete	Did not arm or fire
2	93	100	100	2 3/4	Concrete	"
3	94	100	100	3 1/4	Dirt	"
4	95	100	100	3 1/4	Concrete	"
5	96	100	100	3 1/4	Concrete	Did not arm or fire - Bomb bounced and hit on tail.

Note - Figure 7, Appendix (A), is a photograph of the recovered fuzes.

Fuzing System for XSAM-N-4, Guided Missile Dove, Testing of

TABLE III

TEST DATA

ON

FUZE RELIABILITY, WATER IMPACT

Item Under Test: Fuze, XB-444, with extender and vane from M162 fuze - vane angle 60 degrees
Test Vehicle: AN-M64 500 lb. TNT fully loaded bomb with AN-M109A1 tail
Dropping Aircraft: TBM-3E type
Date Test Performed: 12 March 1952

Drop No.	Fuze No.	True Release Altitude (feet)	Indicated Airspeed (knots)	Impact Delay ± .01 Seconds (seconds)	Remarks
1	183	8,000	150	.32	Satisfactory
2	188	"	"	.32	"
3	200	"	"	.33	"
4	201	"	"	.32	"
5	202	"	"	.29	"
6	203	"	"	---	Not in Camera Field
7	204	"	"	.32	Satisfactory
8	206	"	"	.35	"

TABLE IV

TEST DATA

on

VANE FUZE ARMING DELAY

Item Under Test: Fuze, XB-44A (modified for electric contact), with extender and vane from M162 fuze.
Test Vehicle: AN-M64A1, 500 lb. inert loaded bomb with AN-M109A1 fin assembly. Flash bulbs to indicate release and arming mounted on fin.

Test No.	Test Date	Release Altitude (feet)	I.A.S. (knots)	Arming Vane Length (inches)	Arming Vane Angle (degrees)	Arming Time (seconds)	Remarks
1	6/19/51	3,000	120	1 1/2	45	---	Arming flash not seen
2	"	"	"	1 1/4	45	5.4	Satisfactory drop
3	"	"	"	1 1/8	45	---	Arming flash not seen
Testing secured until location of flash bulbs could be changed.							
4	7/6/51	3,000	120	1 1/8	45	---	Arming flash not seen
Testing secured until additional flash bulbs could be located on bomb.							
5	7/17/51	2,500	180	1 1/8	45	---	Arming flash not seen
6	"	2,500	180	1 1/4	45	---	Arming flash not seen
Testing secured until arming flash bulbs could be replaced by smoke puff.							
7	7/30/51	2,000	140	1 1/2	45	3.5	Satisfactory drop
8	7/30/51	2,000	140	1 1/8	45	4.4	Satisfactory drop
Further test work accomplished by withdrawing arming wire without dropping the bomb. Flash bulbs used to indicate arming and release.							
9	8/13/51	No release	200	1 1/2	45	2.6	Satisfactory data
10	"	"	"	"	60	6.9	Satisfactory data
11	"	"	"	"	55	---	Unreliable data
12	"	"	"	"	56	3.2	Satisfactory data
13	"	"	"	"	60	---	Unreliable data

Fuzing System for XSAM-N-4, Guided Missile Dove, Testing of

DISTRIBUTION

Bureau of Ordnance	
Ad3	1
Re2	1
Re2b	3
Chief of Ordnance, Department of the Army Attn: ORDTX-AR	2
Attn: ORDTQ	1
Commanding General, Aberdeen Proving Ground Aberdeen, Maryland Attn: Technical Information Section, Development and Proof Services	1
Commander, Operational Development Force, U. S. Atlantic Fleet, U. S. Naval Base, Norfolk 11, Virginia	1
Naval Research Section Library of Congress, Washington 25, D. C. (Via BUORD Re2)	2
Naval Gun Factory	2
Naval Gun Factory Attn: Aircraft Armament Section	1
Bureau of Aeronautics Attn: Armament Section	2
NATC, Patuxent River, Maryland	3
Naval Auxiliary Air Station Chincoteague, Virginia	1
Air Material Command Liaison Officer Wing 3 Headquarters, Aberdeen Proving Ground Aberdeen, Maryland	2
Naval Liaison Officer USAFPGC, Eglin Field, Florida	1

DISTRIBUTION (Continued)

NOTS, Invokern, California	1
NOP, Macon, Georgia	1
Naval Air Development Center Johnsville, Pennsylvania	1
U. S. Air Force AMC Engineering Field Office Room 1833, Main Navy Building Navy Department, Washington, D. C.	2
Commander (DF) Naval Ordnance Laboratory	3
Picatinny Arsenal, Dover, New Jersey	1
Commanding Officer, Picatinny Arsenal, Dover, New Jersey Attn: Technical Division	1
Commanding Officer Picatinny Arsenal Dover, New Jersey Attn: Technical Division-Bomb Unit	1
Naval Ammunition Depot, Bangor, Washington Attn: QCS Laboratory	1
Naval Ammunition and Net Depot, Seal Beach, California Attn: QCS Laboratory	1
Naval Ammunition Depot, Crane, Indiana Attn: QCS Laboratory	1

DISTRIBUTION (Continued)

Naval Mine Depot, Yorktown, Virginia Attn: QCS Laboratory	1
Commanding General Air Force Armament Center Attn: Technical Library Eglin Air Force Base, Florida	1
Local	
OV	1
OVX	1
OKB	1
File	1